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ASSESSING CHICKPEA PERFORMANCE IN RESPONSE TO SEAWEED EXTRACT APPLICATION

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ABSTRACT

A commercial product derived from seaweed, known as Sagarika granules and Sagarika liquid which play a significant role in regulating plant growth, amino acids, as well as vital macro and micronutrients. The present investigation was carried out with the objective to assess the performance of chickpea (*Cicer arietinum* L.) under influence of different doses and methods of application of seaweed extract on growth and yield of chickpea at the Agricultural Research Farm, Graphic Era Hill University, Dehradun, Uttarakhand during the Rabi season of 2022-23. The experiment consisted of nine treatments which were replicated three times and laid out in arandomized block design viz. Control (T1), 100% RDF broadcasted (T2), 100% RDF applied in furrow (T3), SWE @ 40 kg/ha broadcasted (T4), SWE @ 40 kg/ha applied in furrow (T5), 75% RDF + SWE @ 10 kg/ha broadcasted + foliar spray of SWE @ 0.25% (T6), 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T7), 50% RDF + SWE @ 20 kg/ha broadcasted + foliar spray of SWE @ 0.25% (T8) and 50% RDF + SWE @ 20 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T9). Application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T7) resulted in significantly higher grain yield, straw yield and biological yield. The grain yield and straw yield were also be found significantly higher by 25.4% and 26.4% over control. Similarly, higher net return and B:C ratio were recorded with the application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T7). Hence, it is concluded that application of 75 % RDF + SWE @ 10 kg/ha applied in furrows + foliar spray of 0.25 % of SWE exhibited higher yield and economics.

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Keywords: Seaweed extract, Sagarika, amino acid, chickpea, furrow, broadcasted, foliar spray.

INTRODUCTION

Chickpea, botanically referred as *Cicer arietinum* L., is recognized by various names including Bengal gram, chickpea and gram in English. It is widely identified in India as Chana dal. Chickpea is a major pulse crop of *Rabi* season belonging to the family Fabaceae and known as King of Pulses. It is the third significant produced food legume globally, after thecommon bean and field pea. India produces 66 per cent of the world's chickpeas, making it the greatest producer in the world (FAOSTAT, 2019). The seed constitutes the primary edible component of the plant, serving as the principal reservoir of protein and fiber in supplementary foods. Furthermore, it represents a notable reservoir of vitamins and minerals including iron, zinc, folate, and magnesium (Bohra *et al.,* 2016)

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and has 21.1 per cent protein, 61.5 per cent carbohydrate, 5 per cent fat, 6 per cent crude fiber and 2.2 per cent oil (USDA, 2021). Moreover, it is known as poor man's meat and rich man's vegetables due to its great nutritional content. This pulse crop becomes increasingly important during times of famine. Chickpea is also play an important role in maintaining soil fertility by fixing nitrogen (N) up to 140 kg/ha/year (Flowers *et al.,* 2010). Chickpea crop requires relatively low inputs of nitrogen as it derives 70 per cent of its N through symbiotic N_2 fixation and benefits other cereal crops as well (Siddique *et al.,* 2005).

Chickpea (*Cicer arietinum* L.) is the third significant produced food legume globally, after the common bean and field pea. India produces 66% of the world's chickpeas, making it the greatest producer in the world (FAOSTAT, 2019). Globally, chickpea occupies an area of 13 Mha with a production of 12.4Mt across 56 countries with a productivity of 1014.6 kg/ha (FAOSTAT, 2020), whereas in India, chickpea is cultivated over an area of 9.44 Mhawith an average production of 15 Mt and productivity of 1073 kg/ha (Directorate of Economics and Statistics, 2019-20).

It is essential to establish standardized agronomic practices for crops to optimize their yield potential. A combination of different nutrient application methods can serve as an effective approach, which includes foliar sprays and soil application, it offers numerous benefits in meeting the plant's nutritional needs. This approach is strategically crafted to address challenges such as nutrient fixation, immobilization and flower drop. The quantity of flowers that undergo natural drop significantly influences the yield and various yield-related characteristics in pulse crops. Ensuring the plant retains its flowers ultimately results in a yield that surpasses initial expectations.

MATERIAL AND METHODS

A field experiment was conducted during the *rabi* season of 2022-23 using chickpea (PG-5) at the Agricultural Research Farm, Graphic Era Hill University, Dehradun,Uttarakhand. The experiment consisted of nine treatments which were replicated thrice and laid out in a randomized block design *viz*., Control (T_1), 100% RDF broadcasted (T_2), 100% RDF applied in furrow (T_3), SWE @ 40 kg/ha broadcasted (T_4), SWE @ 40 kg/ha applied in furrow (T_5), 75% RDF + SWE @ 10 kg/ha broadcasted + foliar spray of SWE @ 0.25% (T_6), 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_7), 50% RDF + SWE @ 20 kg/ha broadcasted + foliar spray of SWE @ 0.25% (T_8) and 50% RDF + SWE @ 20 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_9). The soil of experimental field was low in organic carbon (0.42), medium in available nitrogen (315.2), available phosphorous (48.4) and available potassium (261.2) with neutral soil reaction. The recommended dose of fertilizer adopted was 25 kg N/ha, 50 kg P/ha and 25 kg K/ha. Nitrogen, phosphorus and potassium were supplied through urea, DAP and MOP. Full dose of phosphorus and potassium whereas half dose of nitrogen was applied as basal. Remaining half dose of nitrogen was supplied as top dressing at 45 DAS. Sagarika is a commercial product of IFFCO was used both in granule and liquid form as per the treatment. Yield, yield attributes and production economics (total cost of cultivation, gross return, net return, and benefit-cost ratio) of chickpea under different nutrient management options were recorded.

RESULTS AND DISCUSSION

Yield

Seed, straw and biological yields of chickpea as presented in Table 1 varied significantly under the influence of various treatments. Maximum seed (20.7 q/ha), straw (39.7 q/ha) and biological (60.4 q/ha) yields of chickpea were obtained with 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_7) which was closely followed by the application of 100% RDF applied in furrow (T_3) (seed yield: 19.1 q/ha, straw yield: 37.2 q/ha and biological yield: 56.3 q/ha), 50% RDF + SWE @ 20 kg/ha applied through broadcasted + foliar spray of SWE @ 0.25% (T_8) (seed yield: 19.3 q/ha, straw yield: 38.0 q/ha and biological yield: 57.3 q/ha) and 50% RDF + SWE @ 20 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_9) (seed yield:19.5 q/ha, straw yield: 38.7 q/ha and biological yield: 58.2 q/ha). Percentage of seed and straw yields increase over absolute control (25.4% and 26.4% respectively). As harvest index is a consequence of grain yield and biological yield, the harvest index (34.4%) for chickpeas was observed in the absolute control group (T_1), which was followed by (34.3%) with the application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_7).

Combined application of seaweed extracts (Sagarika) and chemical fertilizers resulted in significant enhancements in both seed and straw yield. This positive outcome can be attributed to the beneficial effects on yield-related characteristics and the dry matter accumulation respectively. The outcome concurred with the discoveries made by Bastia *et al.* (2013), Rathore *et al.* (2009), Ghosh *et al.*(2020), Nayak *et al.* (2020) and Shankar *et al.*(2020). Similarly, Khan *et al.* (2009) documented favorable impacts of phytohormones (such as betaines and cytokinins), minerals, vitamins, amino acids, enzymes, and other components found in seaweed extracts on the grain and biological yields of numerous crops.

Economics

Economic analysis as shown in Table 2 indicated that integrated application seaweed extract and RDF increased the gross return, net return and benefit cost ratio of chickpea cultivation as compared to absolute control (T_1). Among various nutrient management options, although application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% (T_7) recorded highest gross return (₹ 140760/ha) due to best crop productivity and highest net return (₹ 99851/ha) of chickpea cultivation. This was due to relatively low cost of seaweed extract granule. Absolute control recorded lowest gross (₹ 1,12,200/ha) whereas lowest net return (₹ 74806/ha) was recorded with SWE @ 40 kg/ha applied through broadcasted (T_4) of chickpea cultivation due to lowest crop productivity. Because of high monetary returns as well as low cost of cultivation, the maximum benefit-cost ratio (BCR) was recorded under treatment T_7 (2.44) which was however very closely followed by treatment T_8 (2.33). Conversely, minimum BCR (1.86) was acquired by application of 100% RDF through broadcast (T_2). The outcome concurred with the discoveries made by Pramanick *et al.* (2014), Nayak *et al.* (2020) and Singh *et al.* (2021).

Table 1: Effect of different doses and methods of application of seaweed extract on yield of chickpea.

Treatment	Seed Yield (q/ha)	Straw Yield (q/ha)	Biological Yield (q/ha)	Harvest Index (%)
Control	16.5	31.4	47.9	34.4
100%RDF(Broadcasted)	17.4	34.3	51.7	33.6
100%RDF(Furrow)	19.1	37.2	56.3	33.9
SWE@40 kg/ha(Broadcasted)	16.8	33.6	50.4	33.3
SWE@ 40kg/ha(Furrow)	17.5	34.3	51.8	33.7
75%RDF+SWE@ 10 kg/ha (broadcasted) + SWE@0.25%(foliarspray)	17.6	34.5	52.1	33.7
75%RDF+SWE @10kg/ha(furrow)+ SWE@ 0.25%(foliarspray)	20.7	39.7	60.4	34.3
50%RDF+SWE@ 20 kg/ha (broadcasted) + SWE@0.25% (foliarspray)	19.3	38.0	57.3	33.6
50%RDF+SWE @20kg/ha(furrow)+ SWE@ 0.25%(foliarspray)	19.5	38.7	58.2	33.5
SEm±	0.7	1.7	1.9	1.2
CDat5%	2.1	5.0	5.8	NS

CONCLUSION

Based on the findings derived from the current investigation it is concluded that application of 75% RDF + SWE @ 10 kg/ha applied in furrow + foliar spray of SWE @ 0.25% of SWE exhibited higher yield along with a high net returns and B:C ratio. This was able to be produced maximum yield and economics because of the better nutrient supply with seaweed extract and RDF.

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Table 2: Effect of different doses and methods of application of seaweed extract on economics of chickpea.

Treatments	Gross Return	Net Return	B:C
Absolute control 0	112200.0	75102.0	2.02
100% RDF (broadcast)	118546.7	77102.7	1.86
100% RDF(furrow)	129653.3	87209.3	2.05
SWE @40 kg/ha (broadcast)	114240.0	74806.0	1.90
SWE@ 40kg/ha (furrow)	119000.0	78566.0	1.94
75% RDF+SWE@10kg/ha (broadcast) +SWE@0.25% (foliar spray)	119680.0	79771.0	2.00
75% RDF +SWE@ 10kg/ha (furrow) +SWE @0.25% (foliar spray)	140760.0	99851.0	2.44
50% RDF+SWE@20kg/ha (broadcast) +SWE@0.25% (foliarspray)	131466.7	91945.7	2.33
50% RDF +SWE@ 20kg/ha (furrow) +SWE @0.25% (foliar spray)	132373.3	91852.3	2.27
SEm±	4820.3	4820.3	0.12
CD at 5%	14451.3	14451.3	0.37

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